

REMARKS

The Examiner's Action mailed on April 17, 2008, has been received and its contents carefully considered.

In this submission, the specification and claims 1 – 15 have been amended, and claims 16 – 19 have been added. Claim 1 is the independent claim, and claims 1 – 19 are pending. For at least the following reasons, it is submitted that the application is in condition for allowance.

In the Office Action, the specification has been objected to under 35 U.S.C. 112 for informalities. In response, the specification has been amended to correct the matters noted in the Office Action, as well as other informalities noted in the review. It is thus submitted that the objection be withdrawn.

Further, claims 1, 4, 6, 8-11 have been objected to in the Office Action under 35 U.S.C. 112 for informalities. In response, the claims have been amended to correct the matters noted in the Office Action, as well as other informalities noted in the review. It is thus submitted that the objection be withdrawn.

In addition, claim 1 has been rejected in the Office Action under 35 U.S.C. 102(b) as being anticipated by Hickel et. al. (US 5,580,612, hereinafter simply referred to as *Hickel*). It is submitted that the amended independent claim 1 is *prima facie* patentable over the cited reference for at least the following reasons.

Amended independent claim 1 is directed to a method of arranging carbon nanotubes at selective orientations on the surface of a substrate. The method includes the steps of chemically modifying purified carbon nanotubes by attaching organic macromolecules with hydrophilic and hydrophobic ends to the surface of the carbon nanotubes, and dissolving the chemically modified carbon nanotubes in water or a organic solvent to form a solution. The solution is then spread on a body of water to form a carbon nanotubes thin film. The thin film is then compressed and transferred to a treated solid substrate to form a layer of selectively oriented carbon nanotubes.

Hickel is directed to a method of producing of a layer element containing at least a layer of an amphiphilic molecule and one fullerene. This method includes dissolving a

mixture of the amphiphilic molecule and the fullerene in a volatile organic solvent to form a solution (see column 3, lines 39 – 41). The solution is then spread on a water surface to form a film, and the film is compressed and transferred to a solid base (see column 3, lines 41 – 46).

The claimed invention is *prima facie* patentable over *Hickel* because *Hickel* does not disclose or suggest the following steps that are recited in claim 1: (1) chemically modifying carbon nanotubes by attaching organic molecules with hydrophilic and hydrophobic ends to the surface of the carbon nanotubes; and (2) dissolving the chemically modified carbon nanotubes in water or an organic solvent.

First, *Hickel* teaches to make a mixture of amphiphilic molecules and a fullerene. But even assuming, for the sake of argument, that *Hickel*'s fullerene can be equated to the carbon nanotubes of the claimed invention, a mixture cannot be equated to a chemical modification. "In chemistry, a mixture is a substance made by combining two or more different materials **without a chemical reaction** occurring" (see Wikipedia at <http://en.wikipedia.org/wiki/Mixture>), while claim 1 teaches to **chemically modify** one molecule (the carbon nanotube) by attaching a different molecule (the organic macromolecule) to the molecule's surface. Therefore, the step of chemically modifying carbon nanotubes cannot be anticipated by the teachings of *Hickel*.

Second, *Hickel* teaches to dissolve the mixture in a **volatile organic solvent** to form a solution. In contrast, claim 1 specifies to dissolve the chemically modified carbon nanotubes in **water or organic solvent** to form a solution. Because fullerenes are formed entirely of carbon, they are not water-soluble unless chemically modified to have hydrophilic surfaces. Thus, *Hickel*'s teaching to use only volatile organic solvent for a solution is consistent with its teaching to form a mixture of fullerenes and amphiphilic molecules, in which the fullerenes remain water-insoluble due to a lack of chemically attached hydrophilic surface molecules. On the other hand, although carbon nanotubes, like fullerenes, are made entirely of carbon, they are chemically modified according to the claimed invention to provide organic molecules with **hydrophilic and hydrophobic** ends attached to their surfaces, and therefore they can be dissolved in water or organic solvent.

Indeed, *Hickel* teaches away from adopting a chemical modification step for the purpose of making a fullerene molecule water-soluble because it explains that “a characteristic feature of the Langmuir-Blodgett method [as used in *Hickel*] is that **water-insoluble** molecules . . . are spread from a solution . . . on the water surface” (emphasis added, column 3, lines 30 – 33) and “[therefore in] particular, a mixture of the fullerene and amphiphilic compound is dissolved in a volatile organic solvent” (column 3, lines 39 – 41). But as recited in the present original specification (see page 1, lines 14 – 17 and page 2, 7 – 10), the insolubility of carbon nanotubes in an aqueous solution is one of the major limitations for carbon nanotube application breakthroughs, and it is one of the purposes of the present invention to overcome this disadvantage of the existing techniques. Therefore, not only does *Hickel* not disclose or suggest the features recited in claim 1, the step of chemical modification and the step of dissolving of the chemically modified carbon nanotubes in water, but its language also discourages any efforts to develop them. It is therefore submitted that the claimed invention is *prima facie* patentable over the cited reference and that the rejection accordingly should be withdrawn.

Moreover, under 35 U.S.C. 103(a), the Examiner has rejected claims 2-3 as being unpatentable over *Hickel* in view of *Ligenza* (US 2,930,722), claim 4 as being unpatentable over *Hickel* in view of *Fujimaki et al* (US 4,009,305), claim 5 as being obvious over *Hickel*, and claims 6-15 as being unpatentable over *Hickel* in view of *Uekita et al.* (US 5,043,248). Because claims 2 – 15 depend from claim 1, and further because none of the cited references disclose or suggest the features recited in claim 1, it is submitted that claims 2 – 15 are *prima facie* patentable over the cited references for the same reasons that claim 1 is patentable, as well as for the additional features recited therein. It is thus submitted that the rejections should be withdrawn.


Accordingly, it is submitted that the application is in condition for allowance and such a Notice, with allowed claims 1 - 19, earnestly is solicited.

Should the Examiner feel that a conference would help to expedite the prosecution of this application, the Examiner is hereby invited to contact the undersigned counsel to arrange for such an interview.

No fee is believed due. Should any fee be required, however, the Commissioner is hereby authorized to charge the fee to our Deposit Account No. 18-0002, and advise us accordingly.

Respectfully submitted,

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Date


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